PB-250 699

BALDWIN LAKE, RANDOLPH COUNTY, ILLINOIS

Pacific Northwest Environmental
Research Laboratory

Prepared for:

National Environmental Research Center

June 1975

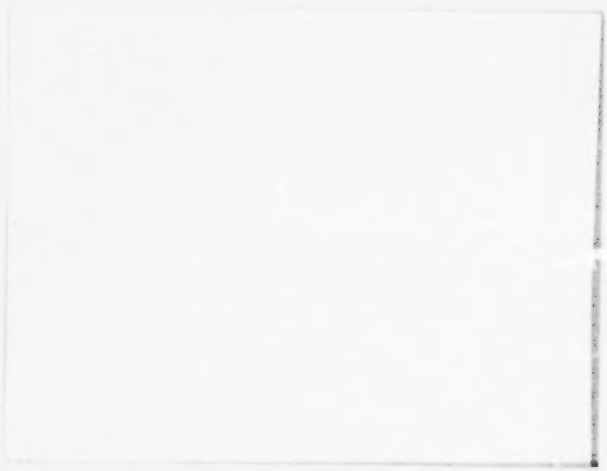
DISTRIBUTED BY:

NTIS

National Technical Information Service
U. S. DEPARTMENT OF COMMERCE

PB 250 699

U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY
WORKING PAPER SERIES



CORVALLIS ENVIRONMENTAL RESEARCH LABORATORY - CORVALLIS, OREGON

and

ENVIRONMENTAL MONITORING & SUPPORT LABORATORY - LAS VEGAS, NEVADA

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U. S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

P.O. 699-440

41

083031

REPORT
ON
BALDWIN LAKE
RANDOLPH COUNTY
ILLINOIS

EPA REGION V

WORKING PAPER No. 295

WITH THE COOPERATION OF THE

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

AND THE

ILLINOIS NATIONAL GUARD

JUNE, 1975

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO.	3. RECIPIENT'S ACCESSION NO. PB250699
4. TITLE AND SUBTITLE: Report on Baldwin Lake, Randolph County, Illinois	5. REPORT DATE: Prepared June 1975
	6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S): Anonymous (National Eutrophication Survey Staff)	8. PERFORMING ORGANIZATION REPORT NO.: Working Paper # 295
9. PERFORMING ORGANIZATION NAME AND ADDRESS: Pacific Northwest Environmental Research Laboratory U.S.Environmental Protection Agency 200 S. W. 35th St. Corvallis, Oregon 97330	10. PROGRAM ELEMENT NO.: 1BA029 11. CONTRACT/GRANT NO.:
12. SPONSORING AGENCY NAME AND ADDRESS: Office of Research and Development U.S. Environmental Protection Agency 401 M Street, S. W. Washington, DC 20460	13. TYPE OF REPORT AND PERIOD COVERED: Final - 1973 14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES
Prepared in cooperation with the U.S. Environmental Protection Agency, National Environmental Research Center, Las Vegas, Nevada 89114

16. ABSTRACT
Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivded according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI FIELD/GROUP
eutrophication lakes nutrients phosphorus nitrogen loading		05B 05C

PRICES SUBJECT TO CHANGE

18. DISTRIBUTION STATEMENT: Release unlimited	19. SECURITY CLASS (This Report)	21. NO. OF PAGES: 41
	20. SECURITY CLASS (This Page)	22. PRICE: $4.00-2.25

1a

CONTENTS

	Page
Foreword	ii
List of Illinois Study Lakes	iv
Lake and Drainage Area Map	v
Sections	
I. Conclusions	1
II. Lake and Drainage Basin Characteristics	3
III. Lake Water Quality Summary	4
IV. Nutrient Loadings	8
V. Literature Reviewed	13
VI. Appendices	14

FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to fresh water lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Illinois Environmental Protection Agency for professional involvement and to the Illinois National Guard for conducting the tributary sampling phase of the Survey.

Dr. Richard H. Briceland, Director of the Illinois Environmental Protection Agency; and Ronald M. Barganz, State Survey Coordinator, and John J. Forneris, Manager of Region III, Field Operations Section of the Division of Water Pollution Control, provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

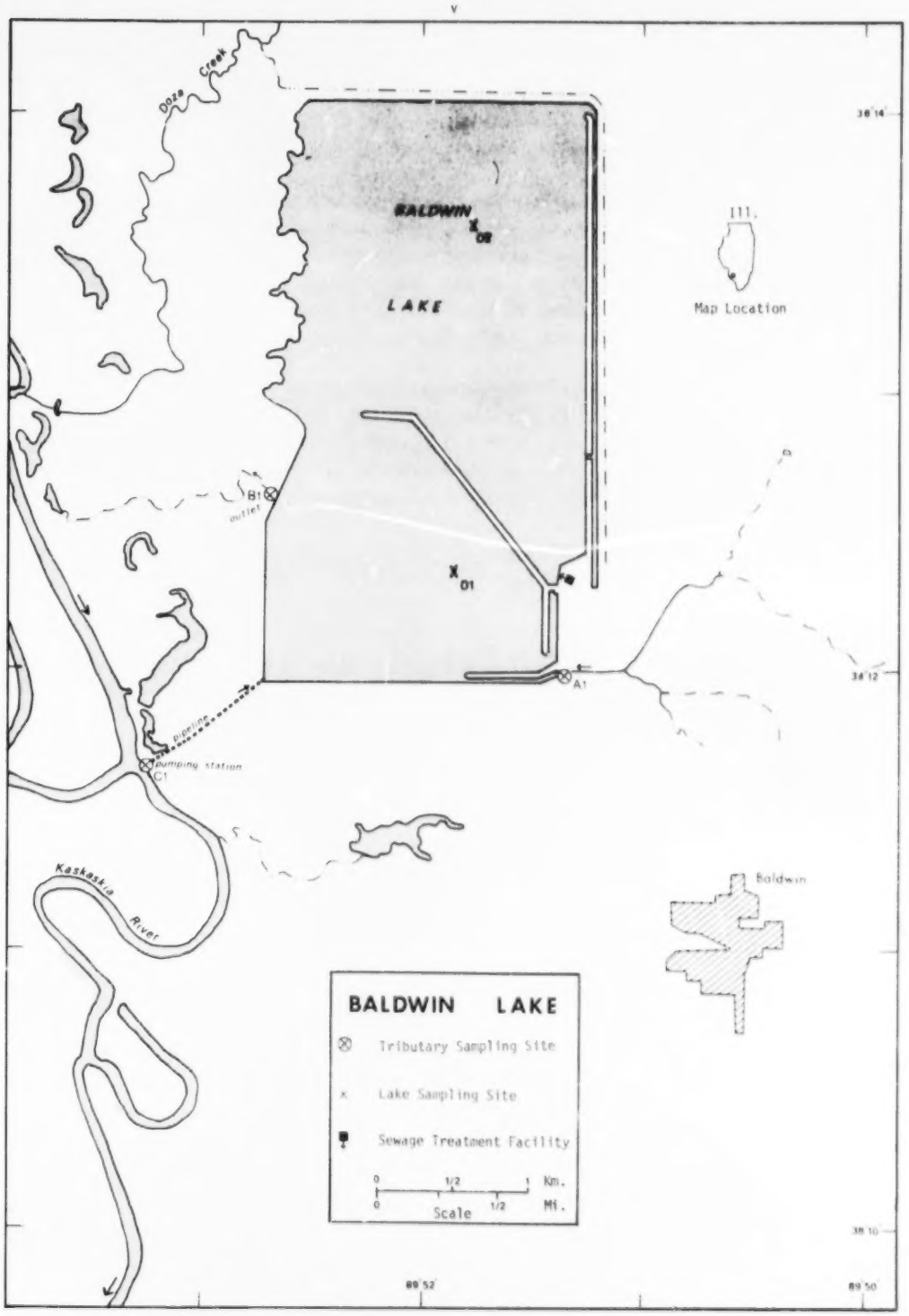
Major General Harold R. Patton, the Adjutant General of Illinois, and Project Officer Colonel Daniel L. Fane, who directed the volunteer efforts of the Illinois National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF ILLINOIS

LAKE NAME	COUNTY
Baldwin	Randolph
Bloomington	McLean
Carlyle	Bond, Clinton, Fayette
Cedar	Lake
Charleston	Coles
Coffeen	Montgomery
Crab Orchard	Jackson, Williamson
Decatur	Macon
DePue	Bureau
East Loon	Lake
Fox	Lake
Grass	Lake
Highland Silver	Madison
Holiday	LaSalle
Horseshoe	Madison
Long	Lake
Lou Yaeger	Montgomery
Marie	Lake
Old Ben Mine	Franklin
Pistakee	Lake, McHenry
Raccoon	Marion
Rend	Franklin, Jefferson
Sangchris	Christian
Shelbyville	Moultrie, Shelby
Slocum	Lake
Springfield	Sangamon
Storey	Knox
Vandalia	Fayette
Vermilion	Vermilion
Wee Ma Tuk	Fulton
Wonder	McHenry


Doze Creek
BALDWIN
LAKE
D2
D1
B1
outlet
A1
pumping station
C1
Kaskaskia River
Ill.
Map Location
Baldwin
38°14
38°12
38°10
89°52
89°50
BALDWIN LAKE
Tributary Sampling Site
Lake Sampling Site
Sewage Treatment Facility
0 1/2 1 Km.
0 1/2 Mi.
Scale

BALDWIN LAKE

STORET NO. 1763

I. CONCLUSIONS

A. Trophic Condition:

Survey data show that Baldwin Lake is eutrophic. It ranked second in overall trophic quality when the 31 Illinois lakes sampled in 1973 were compared using a combination of six parameters*. Two of the lakes had less median total phosphorus, none had less median dissolved phosphorus, one had less median inorganic nitrogen, six had less mean chlorophyll a, and four had greater mean Secchi disc transparency. Marked depression of dissolved oxygen occurred at sampling station 1 in August.

B. Rate-Limiting Nutrient:

The algal assay results indicate phosphorus limitation at the time the assay sample was collected (05/07/73). The lake data also indicate phosphorus limitation; i.e., the mean N/P ratios were 17/1 or greater at all sampling times.

C. Nutrient Controllability:

1. Point sources--The phosphorus load from the wastewater treatment plant serving the Baldwin Power Plant was estimated to be 1.3% of the total load reaching the lake during the sampling year. The present loading rate of 0.58 $g/m^2/yr$ is

* See Appendix A.

almost five times that proposed by Vollenweider (Vollenweider and Dillon, 1974) as a eutrophic rate (see page 12). Baldwin Lake is a large, relatively shallow lake maintained primarily for evaporative cooling in power production at the Baldwin Power Plant. It has been assessed as a "normal, healthy lake" without a serious algae problem but with excessive rooted aquatic plants being supported by nutrients trapped in the lake bottom (Miller, 1973). Based on the data presented herein, phosphorus control at the Baldwin wastewater treatment plant probably would not improve the trophic condition of Baldwin Lake appreciably.

2. Non-point sources--Most of the phosphorus load (95.7%) is estimated to have originated from non-point sources. A pumping station on the Kaskaskia River was the primary source of make-up water to supplement natural inflow during the sampling year. This source of water was also the major source of phosphorus (93%) during the sampling year. The other gaged tributary (A-1) was estimated to have contributed 2.1%, while the ungaged drainage areas contributed less than 1%.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS†

A. Lake Morphometry††:

1. Surface area: 8.00 kilometers^2.
2. Mean depth: 3.1 meters.
3. Maximum depth: 12.2 meters.
4. Volume: 24.800 x 10^6 m^3.
5. Mean hydraulic retention time: 7.9 years (based on outlet flow).

B. Tributary and Outlet:
(See Appendix C for flow data)

1. Tributaries -

Name	Drainage area (km^2)*	Mean flow (m^3/sec)*
Unnamed Stream (A-1)	4.0	<0.1
Pumped flow from Kaskaskia River	-	0.7
Minor tributaries & immediate drainage -	0.6	0.1
Totals	4.6	0.9

2. Outlet -

Kaskaskia River (inflow and outflow difference is evaporative loss)	12.6**	0.1

C. Precipitation***:

1. Year of sampling: 118.4 centimeters.
2. Mean annual: 102.0 centimeters.

---

† Table of metric conversions--Appendix B.
†† Miller, 1973.
* For limits of accuracy, see Working Paper No. 175, "...Survey Methods, 1973-1976".
** Includes area of lake.
*** See Working Paper No. 175.

III. LAKE WATER QUALITY SUMMARY

Baldwin Lake was sampled three times during the open-water season of 1973 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from two stations on the lake and from a number of depths at each station (see map, page v). During each visit, a single depth-integrated (near bottom to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the first visit, a single 18.9-liter depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 9.1 meters at station 1 and 4.9 meters at station 2.

The lake sampling results are presented in full in Appendix D and are summarized in the following table.

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR BALDWIN LAKE
STORET CODE 1763

PARAMETER	1ST SAMPLING (5/ 7/73) 2 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (8/10/73) 2 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (10/17/73) 2 SITES RANGE	MEAN	MEDIAN
TEMP (C)	18.7 - 19.2	19.0	19.2	28.4 - 33.6	30.7	30.1	21.5 - 22.1	21.8	21.9
DISS OXY (MG/L)	8.7 - 10.5	9.3	8.8	1.8 - 8.0	5.3	5.5	7.8 - 7.8	7.8	7.8
CNDCTVY (MCROMO)	470. - 475.	471.	470.	509. - 559.	535.	533.	451. - 471.	457.	453.
PH (STAND UNITS)	8.4 - 8.5	8.5	8.5	7.5 - 8.8	8.2	8.2	8.1 - 8.4	8.2	8.2
TOT ALK (MG/L)	113. - 117.	115.	115.	108. - 117.	110.	109.	113. - 117.	115.	115.
TOT P (MG/L)	0.023 - 0.040	0.030	0.030	0.044 - 0.087	0.054	0.046	0.040 - 0.052	0.045	0.044
ORTHO P (MG/L)	0.003 - 0.004	0.004	0.004	0.007 - 0.020	0.013	0.012	0.004 - 0.010	0.007	0.008
NO2+NO3 (MG/L)	0.030 - 0.050	0.038	0.040	0.060 - 0.230	0.106	0.080	0.110 - 0.150	0.138	0.140
AMMONIA (MG/L)	0.030 - 0.040	0.038	0.040	0.060 - 0.290	0.116	0.080	0.030 - 0.060	0.046	0.050
KJEL N (MG/L)	0.500 - 0.700	0.620	0.600	0.800 - 1.300	0.980	0.900	0.600 - 1.200	0.760	0.700
INORG N (MG/L)	0.060 - 0.090	0.076	0.080	0.130 - 0.520	0.222	0.140	0.140 - 0.210	0.184	0.190
TOTAL N (MG/L)	0.540 - 0.740	0.658	0.650	0.860 - 1.530	1.086	1.000	0.710 - 1.340	0.898	0.840
CHLRPYL A (UG/L)	6.5 - 7.3	6.9	6.9	14.2 - 16.2	15.2	15.2	11.8 - 12.0	11.9	11.9
SECCHI (METERS)	0.9 - 0.9	0.9	0.9	1.0 - 1.2	1.1	1.1	0.9 - 0.9	0.9	0.9

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal units per ml
05/07/73	1. Kirchneriella sp.	866
	2. Oscillatoria sp.	784
	3. Microcystis sp.	757
	4. Scenedesmus sp.	649
	5. Tetrastrum sp. and Crucigenia sp.	649
	Other genera	650
	Total	4,355
08/10/73	1. Nitzschia sp.	921
	2. Merismopedia sp.	877
	3. Microcystis sp.	405
	4. Lyngbya sp.	360
	5. Cyclotella sp.	247
	Other genera	650
	Total	3,460
10/17/73	1. Oscillatoria sp.	1,417
	2. Microcystis sp.	945
	3. Cyclotella sp.	420
	4. Melosira sp.	314
	5. Merismopedia sp.	210
	Other genera	1,365
	Total	4,671

2. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (µg/l)
05/07/73	01	7.3
	02	6.5
08/10/73	01	14.2
	02	16.2
10/17/73	01	11.8
	02	12.0

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.010	0.127	0.1
0.050 P	0.060	0.127	3.2
0.050 P + 1.0 N	0.060	1.127	20.1
1.0 N	0.010	1.127	0.1

2. Discussion -

The control yield of the assay alga, Selenastrum capricornutum, indicates that the potential primary productivity of Baldwin Lake was low at the time the assay sample was collected. The increase in yield when orthophosphorus was added, as well as the lack of increase in yield when nitrogen alone was added, indicate phosphorus limitation.

The lake data also indicate phosphrous limitation (the mean inorganic nitrogen/orthophosphorus ratios were 17/1 or greater at all sampling times).

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the Illinois National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the high runoff months of February and March when two samples were collected. Sampling was begun in June, 1973, and was completed in May, 1974.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Illinois District Office of the U.S. Geological Survey for the tributary sites nearest the lake. The Illinois Power Company provided pumpage data for station C-1 (Kelly, 1975).

In this report, nutrient loads for sampled tributaries were calculated from mean annual concentrations and mean annual flows.

Nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the nutrient exports, in $kg/km^2/year$, at station A-1 and multiplying by the ZZ area in km^2.

Water from the Kaskaskia River, station C-1, is pumped into the lake as make-up water at times when the lake volume is below the usual operation level. Nutrient loads at this station were estimated using the mean concentrations of the nutrients and the mean daily flow for the month.

A. Waste Sources:

1. Known treatment plant* -

Name	Pop. Served	Treatment	Mean Flow (m^3/d)	Receiving Water
Baldwin Power Plant	144	trickling filter	44.3	Baldwin Lake

2. Known industrial - None

* Walden, 1973.

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/ yr	% of total
a. Tributaries (non-point load) -		
Unnamed Stream (A-1)	95	2.1
Kaskaskia River	4,315	93.3
b. Minor tributaries & immediate drainage (non-point load) -	15	0.3
c. Known STP's -		
Baldwin Power Plant	60	1.3
d. Septic tanks - None	-	-
e. Known industrial - None	-	-
f. Direct precipitation* -	140	3.0
Total	4,625	100.0

2. Outputs -

Lake outlet - Kaskaskia River 90

3. Net annual P accumulation - 4,535 kg.

* See Working Paper No. 175.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/ yr	% of total
a. Tributaries (non-point load) -		
Unnamed Stream (A-1)	1,170	2.1
Kaskaskia River	46,285	81.8
b. Minor tributaries & immediate drainage (non-point load) -	175	0.3
c. Known STP's -		
Baldwin Power Plant	310	0.5
d. Septic tanks - None	-	-
e. Known industrial - None	-	-
f. Direct precipitation* -	8,635	15.3
Total	56,575	100.0

2. Outputs -

Lake outlet - Kaskaskia River 4,075

3. Net annual N accumulation - 52,500 kg.

* See Working Paper No. 175.

D. Mean Annual Non-point Nutrient Export by Subdrainage Area:

Tributary	kg P/km²/yr	kg N/km²/yr
Unnamed Stream (A-1)	24	293

E. Yearly Loading Rates:

In the following table, the existing phosphorus loading rates are compared to those proposed by Vollenweider (Vollenweider and Dillon, 1974). Essentially, his "dangerous" rate is the rate at which the receiving water would become eutrophic or remain eutrophic; his "permissible" rate is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic rate would be considered one between "dangerous" and "permissible".

Note that Vollenweider's model may not be applicable to water bodies with short hydraulic retention times.

	Total Phosphorus		Total Nitrogen	
	Total	Accumulated	Total	Accumulated
grams/m²/yr	0.58	0.57	7.1	6.6

Vollenweider loading rates for phosphorus (g/m²/yr) based on mean depth and mean hydraulic retention time of Baldwin Lake:

"Dangerous" (eutrophic rate)	0.12
"Permissible" (oligotrophic rate)	0.06

V. LITERATURE REVIEWED

Kelly, Robert, 1975. Personal communication (pumpage data for station C-1). Baldwin Power Station, Baldwin.

Miller, Wendell E., 1973. Personal communication (lake morphometry). IL Power Co., Decatur.

Vollenweider, R. A., and P. J. Dillon, 1974. The application of the phosphorus loading concept to eutrophication research. Natl. Res. Council of Canada Publ. No. 13690, Canada Centre for Inland Waters, Burlington, Ontario.

Walden, Rawls W., 1973. Treatment plant questionnaire (Baldwin Power Plant STP). IL Power Co., Decatur.

VI. APPENDICES

APPENDIX A

LAKE RANKINGS

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
1703	LAKE BLOOMINGTON	0.050	5.730	464.667	26.200	14.800	0.020
1706	LAKE CARLYLE	0.084	1.270	477.889	17.367	11.000	0.032
1708	LAKE CHARLESTON	0.160	4.680	490.667	12.000	8.400	0.065
1711	COFFEEN LAKE	0.032	0.260	456.222	7.700	14.900	0.012
1712	CRAB ORCHARD LAKE	0.082	0.200	482.222	59.867	13.800	0.013
1714	LAKE DECATUR	0.129	3.750	479.571	43.000	14.500	0.062
1725	LONG LAKE	0.704	1.190	482.667	49.333	8.800	0.398
1726	LAKE LOU YAEGER	0.186	1.600	489.583	10.662	11.400	0.076
1727	LAKE MARIE	0.098	0.370	467.667	39.533	14.700	0.057
1733	PISTAKEE LAKE	0.203	0.370	485.667	75.867	7.000	0.062
1735	REND LAKE	0.071	0.210	471.500	23.533	12.700	0.012
1739	LAKE SHELBYVILLE	0.062	3.290	461.333	17.161	14.800	0.019
1740	SILVER LAKE (HIGHLAND)	0.226	0.970	489.500	5.822	14.800	0.057
1742	LAKE SPRINGFIELD	0.108	3.265	483.385	13.013	10.800	0.059
1748	VERMILION LAKE	0.109	4.695	481.500	31.150	14.200	0.050
1750	WONDER LAKE	0.426	0.890	486.000	98.533	7.800	0.132
1751	LAKE STORY	0.072	2.510	459.333	17.250	14.800	0.021
1752	DEPUE LAKE	0.438	4.050	490.000	58.833	7.600	0.276
1753	LAKE SANGCHRIS	0.050	1.970	475.417	19.292	14.500	0.009
1754	LAKE HOLIDAY	0.167	3.135	485.167	51.217	7.200	0.046
1755	FOX LAKE	0.219	0.375	486.167	63.850	8.800	0.083
1756	GRASS LAKE	0.301	0.820	481.000	83.500	5.900	0.093
1757	EAST LOON LAKE	0.076	0.120	450.000	22.300	14.900	0.018
1758	SLOCUM LAKE	0.865	0.200	487.333	221.100	5.800	0.362
1759	CEDAR LAKE	0.029	0.170	400.333	5.767	12.800	0.013
1761	LAKE WEMATUK	0.069	1.770	466.333	7.967	14.500	0.031
1762	RACCOON LAKE	0.106	0.310	484.333	19.217	13.800	0.020
1763	BALDWIN LAKE	0.044	0.140	461.167	11.333	13.200	0.007

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
1764	LAKE VANDALIA	0.116	0.480	478.111	11.278	14.800	0.023
1765	OLD BEN MINE RESERVOIR	0.930	0.205	478.333	31.433	11.200	0.575
1766	HORSESHOE LAKE	0.127	0.705	482.833	182.250	6.800	0.018

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDEX NO
1703	LAKE BLOOMINGTON	88 (26)	0 (0)	80 (24)	47 (14)	13 (2)	68 (20)	296
1706	LAKE CARLYLE	63 (19)	40 (12)	63 (19)	63 (19)	63 (19)	53 (16)	345
1708	LAKE CHARLESTON	37 (11)	7 (2)	0 (0)	77 (23)	77 (23)	27 (8)	225
1711	COFFEEN LAKE	97 (29)	77 (23)	93 (28)	93 (28)	2 (0)	92 (27)	454
1712	CRAB ORCHARD LAKE	67 (20)	90 (27)	43 (13)	20 (6)	42 (12)	85 (25)	347
1714	LAKE DECATUR	40 (12)	13 (4)	53 (16)	33 (10)	30 (8)	32 (9)	201
1725	LONG LAKE	7 (2)	43 (13)	40 (12)	30 (9)	72 (21)	3 (1)	195
1726	LAKE LOU YAEGER	30 (9)	37 (11)	7 (2)	87 (26)	57 (17)	23 (7)	241
1727	LAKE MARIE	60 (18)	68 (20)	73 (22)	37 (11)	23 (7)	42 (12)	303
1733	PISTAKEE LAKE	27 (8)	68 (20)	23 (7)	13 (4)	90 (27)	32 (9)	253
1735	REND LAKE	77 (23)	80 (24)	70 (21)	50 (15)	53 (16)	92 (27)	422
1739	LAKE SHELBYVILLE	83 (25)	17 (5)	83 (25)	70 (21)	13 (2)	73 (22)	339
1740	SILVER LAKE (HIGHLAND)	20 (6)	47 (14)	10 (3)	97 (29)	13 (2)	42 (12)	229
1742	LAKE SPRINGFIELD	53 (16)	20 (6)	33 (10)	73 (22)	67 (20)	37 (11)	283
1748	VERMILION LAKE	50 (15)	3 (1)	47 (14)	43 (13)	37 (11)	47 (14)	227
1750	WONDER LAKE	13 (4)	50 (15)	20 (6)	7 (2)	80 (24)	13 (4)	183
1751	LAKE STORY	73 (22)	27 (8)	90 (27)	67 (20)	13 (2)	63 (19)	333
1752	DEPUE LAKE	10 (3)	10 (3)	3 (1)	23 (7)	83 (25)	10 (3)	139
1753	LAKE SANGCHRIS	88 (26)	30 (9)	67 (20)	57 (17)	30 (8)	97 (29)	369
1754	LAKE HOLIDAY	33 (10)	23 (7)	27 (8)	27 (8)	87 (26)	50 (15)	247
1755	FOX LAKE	23 (7)	63 (19)	17 (5)	17 (5)	72 (21)	20 (6)	212
1756	GRASS LAKE	17 (5)	53 (16)	50 (15)	10 (3)	97 (29)	17 (5)	244
1757	EAST LOON LAKE	70 (21)	100 (30)	97 (29)	53 (16)	2 (0)	77 (23)	399
1758	SLOCUM LAKE	3 (1)	87 (26)	13 (4)	0 (0)	100 (30)	7 (2)	210
1759	CEDAR LAKE	100 (30)	93 (28)	100 (30)	100 (30)	50 (15)	85 (25)	528
1761	LAKE WENATUK	80 (24)	33 (10)	77 (23)	90 (27)	30 (8)	57 (17)	367
1762	RACCOON LAKE	57 (17)	73 (22)	30 (9)	60 (18)	42 (12)	68 (20)	330
1763	BALDWIN LAKE	93 (28)	97 (29)	87 (26)	80 (24)	47 (14)	100 (30)	504

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500- MEAN SEC	MEAN CHLORA	15- MIN DO	MEDIAN DISS ORTHO P	INDEX NO
1764	LAKE VANDALIA	47 (14)	60 (18)	60 (18)	83 (25)	13 (2)	60 (18)	323
1765	OLD BEN MINE RESERVOIR	0 (0)	83 (25)	57 (17)	40 (12)	60 (18)	0 (0)	240
1766	HORSESHOE LAKE	43 (13)	57 (17)	37 (11)	3 (1)	93 (28)	80 (24)	313

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	1759	CEDAR LAKE	528
2	1763	BALDWIN LAKE	504
3	1711	COFFEEN LAKE	454
4	1735	REND LAKE	422
5	1757	EAST LOON LAKE	399
6	1753	LAKE SANGCHRIS	369
7	1761	LAKE WEMATUK	367
8	1712	CRAB ORCHARD LAKE	347
9	1706	LAKE CARLYLE	345
10	1739	LAKE SHELBYVILLE	339
11	1751	LAKE STORY	333
12	1762	RACCOON LAKE	330
13	1764	LAKE VANDALIA	323
14	1766	HORSESHOE LAKE	313
15	1727	LAKE MARIE	303
16	1703	LAKE BLOOMINGTON	296
17	1742	LAKE SPRINGFIELD	283
18	1733	PISTAKEE LAKE	253
19	1754	LAKE HOLIDAY	247
20	1756	GRASS LAKE	244
21	1726	LAKE LOU YAEGER	241
22	1765	OLD BEN MINE RESERVOIR	240
23	1740	SILVER LAKE (HIGHLAND)	229
24	1748	VERMILION LAKE	227
25	1708	LAKE CHARLESTON	225
26	1755	FOX LAKE	212
27	1758	SLOCUM LAKE	210
28	1714	LAKE DECATUR	201

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
29	1725	LONG LAKE	195
30	1750	WONDER LAKE	183
31	1752	DEPUE LAKE	139

APPENDIX B

CONVERSIONS FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX C

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR ILLINOIS 10/23/75

LAKE CODE 1763 LAKE BALDWIN

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 12.6

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
1763A1	4.0	0.02	0.04	0.05	0.05	0.04	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.02
1763B1	12.6	0.07	0.12	0.15	0.15	0.12	0.10	0.06	0.03	0.02	0.02	0.03	0.04	0.08
1763ZZ	8.6	0.05	0.08	0.10	0.10	0.08	0.07	0.04	0.02	0.01	0.01	0.02	0.03	0.05

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 12.6
SUM OF SUB-DRAINAGE AREAS = 12.6

TOTAL FLOW IN = 0.91
TOTAL FLOW OUT = 0.91

NOTE *** MONTHLY AND DAILY FLOWS WILL BE SUPPLIED BY POWER COMPANY

NO DAILY FLOW DATA ON FILE

APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 75/10/23

176301
38 12 25.0 089 51 55.0
BALDWIN LAKE
17157 ILLINOIS

11EPALES
3

2111202
0010 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/05/07	10 50	0000	18.7		36	475	8.40	116	0.040	0.700	0.040	0.004
	10 50	0006	18.7	10.5		470	8.50	117	0.040	0.600	0.050	0.004
73/08/10	15 05	0000	33.6	5.8	48	558	8.80					
	15 05	0005	30.6			535						
	15 05	0010	30.2	5.6		530	8.30	109	0.070	0.800	0.060	0.010
	15 05	0015	29.8	5.4		525	7.80	110	0.080	0.900	0.100	0.014
	15 05	0020	29.5			520						
	15 05	0025	29.1			520						
	15 05	0030	28.4	1.8		509	7.50	117	0.290	1.300	0.230	0.020
73/10/17	11 20	0000	21.9		37	452	8.30	117	0.050	1.200	0.140	0.010
	11 20	0015	21.7	7.8		451	8.20	117	0.050	0.700	0.140	0.008
	11 20	0026	21.5	7.8		471	8.10	115	0.040	0.600	0.150	0.008

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/05/07	10 50	0000	0.023	7.3
	10 50	0006	0.030	
73/08/10	15 05	0000		14.2
	15 05	0010	0.046	
	15 05	0015	0.045	
	15 05	0030	0.087	
73/10/17	11 20	0000	0.052	11.8
	11 20	0015	0.043	
	11 20	0026	0.044	

STORET RETRIEVAL DATE 75/10/23

176302
38 14 00.0 089 51 50.0
BALDWIN LAKE
17157 ILLINOIS

11EPALES
3

2111202
0013 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/05/07	11 10	0000	19.2		36	470	8.50	115	0.040	0.700	0.030	0.003
	11 10	0005	19.2	8.7		470	8.50	113	0.030	0.600	0.030	0.004
	11 10	0009	19.2	8.8		470	8.40	114	0.040	0.500	0.040	0.003
73/08/10	14 50	0000	33.2	8.0	40	559	8.60	108	0.060	1.100	0.080	0.007
	14 50	0004	32.8			551						
	14 50	0006	30.1	5.4		541	8.10	108	0.080	0.800	0.060	0.012
73/10/17	11 52	0000	22.1		36	458	8.40	115	0.060	0.700	0.150	0.005
	11 52	0016	21.9	7.8		453	8.20	113	0.030	0.600	0.110	0.004

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/05/07	11 10	0000	0.023	6.5
	11 10	0005	0.040	
	11 10	0009	0.035	
73/08/10	14 50	0000	0.044	16.2
	14 50	0006	0.050	
73/10/17	11 52	0000	0.044	12.0
	11 52	0016	0.040	

APPENDIX E

TRIBUTARY and WASTEWATER TREATMENT PLANT DATA

STORET RETRIEVAL DATE 75/10/23

1763A1
38 12 00.0 089 51 22.0
UNNAMED STREAM
17121 7.5 BALDWIN
I/BALDWIN LAKE
CULVERT UNDER DIKE RD AT SE CORNER OF LK
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/06/03	14 20		0.010K	3.075	0.058	0.018	0.135
73/07/07	10 00		0.031	4.000	0.176	0.028	0.120
73/08/04	11 02		0.034	1.150	0.013	0.014	0.070
73/09/02	10 35		0.010K	1.760	0.070	0.032	0.135
73/10/07	09 25		0.035	1.800	0.078	0.012	0.095
73/11/04	10 00		0.160	0.650	0.017	0.029	0.100
73/12/02	09 30		0.380	1.000	0.064	0.120	0.280
74/01/06	10 15		0.990	1.100	0.080	0.100	0.180
74/02/03	09 20		0.570	1.300	0.110	0.070	0.250
74/02/16	09 45		0.650	1.700	0.100	0.050	0.260
74/03/02	15 00		0.336	1.100	0.045	0.020	0.142
74/03/17	15 00		0.340	1.100	0.040	0.020	0.140
74/04/06	11 00		0.400	1.550	0.110	0.025	0.155
74/05/04	09 45		0.016	0.800	0.020	0.005	0.050

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/10/23

176381
38 12 38.0 089 52 40.0
UNNAMED STREAM
17 7.5 RED BUD
O/BALDWIN LAKE
SPILLWAY ON W SIDE OF LAKE
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/06/03	14 40		0.018	3.200	0.067	0.007	0.035
73/07/07	10 31		0.020	4.000	0.110	0.012	0.040
73/08/04	11 29		0.030	2.400	0.037	0.010	0.025
73/09/02	11 47		0.010K	1.540	0.100	0.023	0.045
73/10/07	09 25		0.168	1.100	0.085	0.006	0.040
73/11/04	09 45		0.096	1.200	0.042	0.009	0.040
73/12/02	09 40		0.100	1.100	0.036	0.012	0.045
74/01/06	10 25		0.160	1.000	0.028	0.012	0.020
74/02/03	09 30		0.120	0.600	0.017	0.007	0.035
74/02/16	10 00		0.032	0.800	0.025	0.005	0.035
74/03/02	15 30		0.044	1.600	0.040	0.005	0.050
74/03/17	15 30		0.012	0.500	0.020	0.010	0.035
74/04/06	11 30		0.018	0.900	0.037	0.005K	0.010
74/05/04	09 30		0.140	1.700	0.082	0.014	

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/10/23

1763C1
38 11 40.0 089 53 15.0
KASKASKIA RIVER(PUMPED)
17 7.5 RED BUD
I/BALDWIN LAKE
PUMPING STATION AT SW CORNER OF LAKE
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/08/20	13 00		0.800	0.780	0.048	0.062	0.220
73/09/21	13 00		0.870	1.500	0.250	0.044	0.220
73/10/22	13 00		0.700	0.650	0.042	0.063	0.115
73/11/21	13 15		0.588	0.800	0.068	0.068	0.210
73/12/21	15 00		0.640	0.700	0.072	0.040	0.170
74/01/22	10 00		0.616	0.700	0.052	0.065	0.300
74/02/22	09 10		1.180	0.900	0.065	0.097	0.280
74/03/20	15 30		1.920	1.000	0.035	0.095	0.220
74/04/23	13 30		1.160	1.050	0.140	0.065	0.170
74/05/21	13 30		0.830	0.800	0.035	0.041	0.115
74/06/21	11 00		0.960	1.000	0.010	0.055	0.260
74/07/23	10 30		1.200	0.800	0.045	0.040	0.145
74/08/22	17 00		1.040	0.600	0.020	0.040	0.140

STORET RETRIEVAL DATE 75/10/23

176321 TF176321 P000200
38 12 09.0 089 51 12.0
BALDWIN POWER PLANT
17157 7.5 BALDWIN ILL.
D/BALDWIN LAKE
BALDWIN LAKE
11EPALES 2141204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
73/07/30	12 00								
CP(T)- 73/07/31	12 00		7.400	4.700	0.038	2.200	2.610	0.012	0.012
73/08/20	12 00								
CP(T)- 73/08/21	12 00		8.200	6.700	0.069	2.620	2.900	0.009	0.009
73/09/21	13 00								
CP(T)- 73/09/21	24 00		10.400	7.400	0.180	3.260	3.900	0.010	0.011
73/10/22	12 00								
CP(T)- 73/10/23	12 00		4.000	3.200	0.029		1.700	0.011	0.013
73/11/20	11 00								
CP(T)- 73/11/21	11 00		11.400	11.000	0.660	3.020	3.700	0.011	0.016
73/12/21	15 15		2.600	23.000	5.400	2.400	3.450	0.011	0.012
74/01/20	16 30								
CP(T)- 74/01/21	15 30		2.520	20.000	17.600	3.700	4.900	0.012	0.012
74/02/22	09 00		2.080	8.000	0.220	2.600	3.150	0.014	0.011
74/03/20	12 00								
CP(T)- 74/03/21	11 00		4.400	22.000	8.200	3.300	4.500	0.012	0.012
74/04/22	11 30								
CP(T)- 74/04/23	10 30		7.900	24.000	5.300	3.750	6.600	0.013	0.012
74/05/21	14 00								
CP(T)- 74/05/22	14 00		9.800	13.000	1.150	3.200	4.150	0.011	0.011
74/06/20	10 00								
CP(T)- 74/06/21	10 00		7.600	7.500	3.100	2.700	2.800	0.008	0.010
74/07/23	10 00								
CP(T)- 74/07/24	10 00		12.100	8.600	0.082	3.300	4.000	0.010	0.011